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CTI Chemical Toxicology Institute

1167 Chess Drive, Suite E
P.O. Box 8209

Foster City, California 94404
(415) 573-6222

DIRECTOR
Randall C. Baselt, Ph.D

CO DIRECTOR
Michael A. Peat, Ph.D

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May 24, 1985

Mr. Bruce Vander Kolk
Chief, Bureau of Scientific Services
Division of Support Services
Illinois Dept. of Law Enforcement
726 South College St.
Springfield, IL 62704

Dear Mr. Vander Kolk:

At your request, I spent May 20, 21 and the morning of May 22 reviewing the operation of the Illinois Department of Public Health Toxicology Laboratory in Chicago. I was assisted in this task by Michael Sheppo, Garry Bombard and Jack Welty, Jr. of your division and by their staff. Each of these individuals was at all times courteous, efficient and highly professional in conduct.

I will divide my critical comments into several broad categories in order to structure the report. Mr. Sheppo and his colleagues had taken steps to remedy many of the more serious problems involving laboratory safety and evidence handling prior to my visit and I will therefore avoid those matters for the most part. Also, since the Environmental Analysis Section run by Dr. Grohlich will apparently not come under your jurisdiction, his section will not be discussed by me.

General Laboratory Policies

1. The laboratory does not possess a policy and procedures manual. Such a manual would normally include policies for safety, chemical and biological hygiene, evidence receipt and storage, employee dress and conduct code, reporting of injuries, job descriptions and duties, confidentiality of laboratory data, and employee performance review.

2. A non-smoking policy in the laboratory areas was instituted while I was there. Previously, smoking in these areas was a fire hazard due to the many flammable solvents in the same areas and also presented the

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possibility for nicotine contamination of specimens, glassware and instruments.

3. None of the refrigerators or freezers is currently being monitored for temperature control. Each cooled compartment should have its own thermometer, with the temperature being recorded on a daily log attached to the exterior of the compartment. Each thermometer must be calibrated against an NBS thermometer annually and the calibration records kept in a maintenance manual.

4. The fume hoods must be monitored for air velocity on a periodic basis by an industrial hygienist and the results kept in a maintenance log.

5. All refrigerators and freezers should bear signs reading NO FOOD STORAGE. If a refrigerator/freezer is designated for food storage, it should bear signs reading FOOD STORAGE ONLY.

6. The case folders, containing case histories, evidence receipts and all analytical data, are kept in a variety of locations throughout the laboratory as the work progresses. These should be maintained in a central office location and the analysts should submit their data for filing as work is completed.

7. Analysts currently jot down their findings on the front of the case folder and the final report is apparently prepared from these notes, which are neither initialled nor dated. This system must be replaced by a series of printed forms that indicate all details of the analysis and provide space for raw data and conclusions.

8. There is no inventory of chemicals. Each chemical storage area should have immediately accessible an inventory of chemicals stored within for safety and control purposes.

9. Many reagent bottles are unlabelled or incompletely labelled. Each container must be labelled with the name of the reagent, directions for its preparation, date of preparation, date of expiration (if appropriate), special storage or handling instructions, and initials of the preparer.

10. The cross-index to victims' or defendants' names is only partially alphabetized. This file should be completely alphabetized for accuracy and efficiency.

11. No index of positive case findings exists. This should be set up alphabetically by generic name (i.e., amobarbital, phencyclidine) so that prevalence or blood

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concentration trends can be quickly assessed.

12. A policy against pipetting of chemicals or specimens by mouth must be established immediately.

13. The use of disposable glassware and measuring devices should be encouraged wherever possible to minimize biological hazards and contamination of specimens or their extracts.

14. Written instructions for collecting and submitting specimens are not provided to coroners. These should be prepared and widely circulated, and should include specimen type, volume, method of collection, type of container, and instructions for storage and submission.

Personnel Workload

The personnel complement of 13 funded positions is adequate for the annual workload of approximately 4500 specimens. However, the number of currently filled positions is inadequate for this workload. Additionally, my impression of my brief stay is that the laboratory technicians are improperly trained for their jobs and have a poor technical understanding of the techniques they are performing.

Equipment

Most of the major pieces of instrumentation are outdated or outmoded. At least three large items have not been functional for years and should be removed from the laboratory. The EMIT immunoassay system is generally inappropriate and not sufficiently sensitive for forensic analysis and should be replaced by radioimmunoassay. Only one gas chromatograph is functional for drug screening purposes but is not currently being used. The two gas chromatograph/mass spectrometers are old, inefficient, insensitive and difficult to maintain.

Quality Assurance

1. Detailed written procedures for the majority of the analytical techniques currently being performed are not available in the laboratory.

2. Preventive maintenance manuals and logs of service procedures for each major item of equipment are not available.

3. No calibration of pipets or other volumetric measuring devices is performed.

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4. No calibration of analytical balances is performed.
5. Certified standards or analytical-grade standards are not available for ethanol, drugs, drug metabolites or other substances currently being determined by the laboratory.
6. Calibration of methods is performed using only one standard at a single concentration, generally a standard that has been obtained from a pharmaceutical formulation and that is not carried through the analytical scheme.
7. Neither negative nor positive quality control materials are utilized in most assays, nor are quality control logs kept for any assays.

Ethanol Analysis in Biological Specimens

1. The current 10 mL blood tubes provided for specimen collection by the Division of Implied Consent contain only 25 mg of sodium fluoride. This is inadequate for specimen preservation and the tubes should be replaced with Becton-Dickinson #3200XF525 (or equivalent) containing 100 mg of sodium fluoride.
2. The DUI Laboratory Analysis Report sheet included in the specimen collection list does not provide or allow for information on the disinfectant used to prepare the venipuncture site or the time of first urine void (or if in fact there was a void). Also, the information on the back of the form should indicate that alcohol should not be used as a disinfectant, that the blood tube should be inverted several times after blood collection to prevent coagulation, and that the bladder must be voided one-half hour prior to collection of the urine specimen (as required by Standards and Procedures for Testing for Alcohol).
3. Ethanol determinations are made on both blood and urine specimens from the same defendant, even though Standards and Procedures for Testing for Alcohol indicates that "a urine sample should be considered only when other methods to determine equivalent alcohol concentration in the blood are not practicable."
4. Urine ethanol concentrations are expressed as an actual concentration, without provision for conversion to a blood concentration (i.e., divide by 1.3).
5. Results of ethanol determinations are expressed to

three decimal places. These results should be expressed to two decimal places after dropping the third decimal place.

6. Only one quantitative determination was made per specimen when the measurements were being performed in the DPH Toxicology Laboratory. As a minimum, duplicate determinations should be performed and the results averaged if they agree within 0.010%.

7. Neither the method used by the Dept. of Public Health nor the headspace gas chromatographic technique being temporarily employed utilize a primary standard for calibration. A description of such a method was furnished to Mr. Sheppo.

8. Review of quarterly U.S. Department of Transportation Blood Alcohol Survey results for the period September, 1976 to October, 1984 indicate that the laboratory performed very well on these proficiency tests, never varying by more than 0.01% in blood alcohol concentration from the target value. Yet, re-analysis, by outside laboratories of a number of blood specimens collected from defendants during 1985 show that the Toxicology Laboratory's results have been overestimated by 10-20%. Also, a copy of a proficiency test result report form from a March, 1985 survey conducted by the Department of Public Health bears handwritten results that are about 20% higher than the mean for participating laboratories (and largely outside the acccept-able range), with acceptable figures written crudely over the original data. A possible explanation, pointed out by Mr. Sheppo, for these high ethanol concentrations is that a large number of the laboratory's recent gas chromatograms for ethanol show premature termination of the analysis, with resulting underestimation of the internal standard peak area.

Drug Analysis in Biological Specimens

1. There is not a well-established protocol for drug screening of blood and urine specimens by DUI cases. Dr. Pirl indicated at various times that the cutoff for blood ethanol concentrations, below which specimens would be screened for drugs, was 0.10, 0.11 and 0.12%. He indicated that even at higher ethanol concentrations the specimen would receive drug screening if the description of the defendant's condition did not correlate with the measured ethanol concentration.

   There is no flow chart for drug analysis available in the laboratory, nor is there a list of drugs detected by the usual procedures or their detectability limits.

2. Amphetamine and related stimulants are assayed only if the case history is indicative of their use. The flame-ionization gas chromatograph used for amphetamine analysis is not currently operating.

3. Immunoassay screening is being performed on urine only, since the available equipment does not allow for direct determination in blood (the procedure could be modified to allow this). Also, the EMIT screening that is being done on urine does not include the amphetamines or barbiturates; the reasons given for this were inadequate.

4. Solvent extracts of biological specimens are taken to dryness in glass evaporating dishes, which are stacked up overnight prior to qualitative analysis. Dishes from different cases are stacked one atop the other and the topmost dishes are left uncovered and exposed to the atmosphere.

5. Gas chromatography/mass spectrometry is performed as confirmation for all positive results and is even performed when screening tests are negative but the arresting officer has requested testing for specific drugs. This represents inefficient use of an expensive and time-consuming technique.

6. Quantitation of drugs is not performed on urine or vitreous humor in coroner's cases, although this information is often of interpretive value.

7. EMIT results for urine, if negative, are recorded only as "negative" in (and on) the case folder; i.e., raw absorbance values are not recorded. Even when positive results are obtained, the absorbance values of the specimen and the low calibrator are recorded but not of the negative control.

8. The list of colors and Rf values for a large variety of drugs is not available to the thin-layer chromatography technician, Mr. Paul Manio. Also, he has no standardized directions for the preparation of the urine standards for this technique. The urine standards seem to vary randomly in composition from time to time, and for several of the drugs Mr. Manio was unaware of their concentration in the standards. Identification of drug metabolites is apparently made by educated guess, since standards are not available.

9. Review of proficiency test results from the quarterly University of Utah Forensic Toxicology Survey for 1981 (Table 1) indicate a false positive rate of 1/62 (1.6%)

and a false negative rate of 21/62 (34%). Also, some serious quantitation problems existed, results ranging from 7% to 814% of the mean value for all participants.

10. Review of proficiency results from the quarterly College of American Pathologists Toxicology Survey for March, 1983 through March, 1985 (Table 2) indicate a false positive rate of 8/117 (6.8%) (all occurring since 3-84) and a false negative range of 20/117 (17%). If the false positive rate is determined only for the period March, 1984 to March, 1985, it calculates to 8/73 (11%). Quantitation problems are evident throughout the two-year period, with results ranging from 12% to 1100% of the mean value for all participants.

11. At this point, I will review the analytical data on three recent cases. I was asked to review the first case due to its notoriety, while the others are cases with positive drug findings that were selected at random.

Case 3402-84 (Dr. M.J. Swango, suspect):

Hair samples from 9 individuals were analyzed for arsenic using a modified Gutzeit procedure involving visible spectrophotometry as the endpoint. These 9 individuals were all apparent victims of suspected arsenic poisoning. Hair from 7 of the victims gave absorbance values (after subtracting the reagent blank) of 0.00 to 0.03 (approximate) and these specimens were assigned arsenic concentrations of less than 30 or 40 ug/100 g. Hair from 2 victims gave absorbance values of 0.05 and 0.08 (approximate) and these were estimated at 200 and 412 ug/100, respectively. Apparently, only one calibration standard was used, this being a 1 ug As_2O_3 solution and this gave an absorbance value of 0.04. Determinations on normal control individuals were apparently not performed, nor was any attempt made to differentiate these results from external contamination of the hair by washing the specimens prior to analysis. Also, a confirmatory test such as atomic absorption spectrometry was not performed. These results are suggestive of the presence of arsenic in the hair of at least 2 individuals, but only at levels that could be obtained as a result of chronic exposure to water supplies high in arsenic content in asymptomatic persons. The data neither confirm nor refute the suspicion of criminal poisoning.

Case No. 1546-85:

In this case, a blood specimen was reported to contain 0.002 mg/dL cocaine and 0.05 mg/dL diazepam. I felt the result was curious since nordiazepam was not detected and this metabolite is normally present in blood in detectable quantities when diazepam is found at this level. Review of the

data in the case folder showed that screening tests for drugs had not been performed, but because the arresting officer had requested tests for cocaine and diazepam the specimen had gone directly to gas chromatography/mass spectrometry (GC/MS).

The GC/MS technician, Mr. Yoshimura, informed me that he extracts 4 mL of blood without buffering using 35 mL of ethyl acetate, evaporates the solvent to dryness, dissolves the residue in 40 uL of a mixed solvent and injects 4 uL into the GC/MS. The column packing and column length vary from run to run and no record of the actual conditions was kept. The total ion chromatogram for this blood specimen did not indicate the presence of cocaine or diazepam, but by selecting the appropriate scan numbers where Mr. Yoshimura knew these drugs would elute, he was able to obtain representative spectra for these 2 drugs. The spectra were not library searched. Quantitation was performed by mixing known volumes of methanol solutions of the two drugs (extracted from pharmaceutical formulations or contraband material), mixing with internal standard and injecting directly. Although the technician indicated that this had been done in this case, hard copies of these data were not obtained. Only one calibration standard was used and this standard and the specimen extract were analyzed only once. Neither positive nor negative quality control specimens were used.

These test results in my opinion do not confirm the presence of cocaine or diazepam in this case.

Case No. 878-85:

Positive findings in this case included strychnine in the following concentrations: blood, less than 0.5 mg/dL; urine, positive; gastric contents, positive. The decedent had been found lying in a field without vital signs. Strychnine had not been suspected, but was identified by routine screening of gastric contents by ultraviolet spectrophotometry (UV). UV was used to determine strychnine in urine and to approximate its concentration in blood. Thin-layer chromatography was negative for strychnine in urine. The drug was confirmed in blood, urine and gastric contents by GC/MS.

Strychnine may be present in these specimens, but the negative thin-layer chromatography (TLC) result is perplexing. TLC should have been repeated on urine and should have been used to confirm strychnine in blood and gastric contents. The semi-quantitative blood result is nearly meaningless, since strychnine concentrations of 0.1 to 0.5 mg/dL can cause death. The concentrations of the drug should be accurately determined in all three specimens prior to release of these results.

Conclusions

In my conversations with Mr. Scheppo, Mr. Bombard and Mr. Welty, I was impressed with their descriptions of the Illinois

Department of Law Enforcement's forensic science program and its devotion to accuracy and integrity. They were shocked by the lack of such devotion within the present laboratory. Given your burden of developing a forensic toxicology section under the stringent guidelines that exist in your bureau, I cannot in good conscience recommend that you attempt to salvage any of the methods, equipment or personnel of the Department of Public Health Toxicology Laboratory. As I see it, your only option is to establish a new forensic toxicology laboratory at a different location with different equipment and personnel. I believe that a properly qualified Chief Forensic Toxicologist with two assistants could set up within several months and run a skeleton program for alcohol and selected drugs, perhaps using temporary space and borrowed equipment, that would suffice for the state's DUI cases until a full-scale laboratory could be built. In the meantime, I would recommend that work at the present laboratory be halted and that steps be taken to rectify any errors that may have occurred through the judicial process.

I appreciate your invitation to participate in this review process and wish you success in your endeavors.

Sincerely,

Randall C. Baselt, Ph.D.
Director

TABLE 1

UNIVERSITY OF UTAH FORENSIC TOXICOLOGY SURVEY

Date	Sample No.	Drugs Present	No. False Pos.	No. False Neg.	Quantitation As % of Mean
1-81	1	3	0	0	75,87,100
	2	4	0	0	82,100,200
	3	2	1[1]	0	
	4	3	0	0	7,100,140
	5	3	0	0	
3-81	6	3	0	1[2]	
	7	3	0	2[3]	100
	8	3	0	2[4]	75
	9	3	0	2[5]	17
	10	3	0	2[6]	
5-81	11	1	0	0	78
	12	4	0	2[7]	674,814
	13	4	0	2[8]	53,60
	14	2	0	0	67,99
	15	3	0	0	
7-81	16	3	0	1[9]	58,205
	17	4	0	1[10]	21,29,73
	18	4	1[11]	3[12]	
	19	4	0	1[13]	
	20	3	0	2[14]	63

[1] ethanol in urine
[2] salicylate in urine
[3] flurazepam and desalkylflurazepam in blood
[4] methaqualone and metabolite in blood
[5] methaqualone and metabolite in liver
[6] benzoylecgonine and dextromethorphan in urine
[7] doxepin and nordoxepin in blood
[8] morphine and codeine in blood
[9] ethanol in gastric (not done)
[10] ethanol in blood (found but not reported)
[11] methaqualone in liver
[12] norpropoxyphene, acetaminophen and ethanol in liver (ethanol not done)
[13] ethanol in urine (found but not reported)
[14] morphine and codeine in blood

TABLE 2

COLLEGE OF AMERICAN PATHOLOGISTS TOXICOLOGY SURVEY

Date	Drugs Present	No. False Positives	No. False Negatives	Quantitation As % of Mean
3-83	10	0	0	40,48,74,92,127
6-83	20	0	2	20,20,38,42,54,80,100,106,111,122,539[1]
9/83	(missing)			
12/83	14	0	1	25,85,92,93,96[2],116,163,205,257[3]
3/84	15	1[4]	1[4]	64,70,78,80,80,132
6/84	15	2	1	12[5],41,89,97,100,125,160,160,1111[6]
9/84	15	0	4[7]	63,82,85,100,102,103,118,128
12/84	16	4[8]	6[9]	63,71,78,100,109,112,128,139,171
3/85	12	1[10]	5[11]	(not yet available)

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[1] methamphetamine in serum

[2] ethanol in serum

[3] phenobarbital in serum

[4] transcription error, oxazepam to diazepam (not supported by data)

[5] nordiazepam in serum

[6] nortriptyline in serum

[7] ethchlorvynol (2), acetone, isopropanol in serum

[8] diazepam, nordiazepam, theophylline (2) in serum

[9] benzoylecgonine and oxazepam in urine, morphine, COOH-THC, THC and amoxapine in serum

[10] codeine in urine (may have been present as a contaminant)

[11] amoxapine and chlorpheniramine in urine, amoxapine, ethchlorvynol, and trichloroethanol in serum

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